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Systematic design of high- Q prestressed micro membrane resonators. (English)

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Summary: Quality factor (Q) and frequency-quality factor Qf of prestressed membrane resonators are enhanced by topology optimization. The optimization targets the fundamental mode which is more easily identified in physical experiments compared to high-order modes embedded in possibly dense frequency ranges. Both intrinsic and extrinsic losses are considered in the optimization process. With different combinations of the two damping sources, topology optimization yields distinct designs, which reveals that damping mechanisms significantly affect the optimal geometry of micro resonators. For optimized designs, the Qf in the fundamental mode exceeds the minimum requirement for room-temperature quantum optomechanics (6.2×10^{12} Hz and reaches 10^{13} Hz in numerical experiments).

MSC:

74K15 Membranes

74P15 Topological methods for optimization problems in solid mechanics

Keywords:

topology optimization; prestressed membranes; resonators; quality factor; frequency-quality factor

Software:

top88.m; top.m

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